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THE Be-Ta (BERYLLIUM-TANTALUM) SYSTEM

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9.01218 180.9479

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Equilibrium Diagram

Six intermediate phases have been identified thus far, but little or no information is available concerning the alloy phase relations. Short reviews on this system have been provided by [66Sam] and [73Gol]. Figure 1 shows the position of each phase and melting points where available.

(βBe) and (αBe) Terminal Solid Solutions. The melting point of βBe and the βBe --> αBe allotropic transformation temperature are 1289±4 and 1270±6 °C, respectively [86BAP]. [50Kau] observed a eutectic network in a slowly cooled alloy containing 0.05 at.% Ta. Hence, the solid solubility of Ta in Be is less than this value.

$Be_{12}Ta$ (*7.7 at% Ta*): $Mn_{12}Th$-type, identified by [57Bat] and [57Gla]. Its melting point is 1850 °C according to [59Pai, 60Sto]. The tetragonal compound found earlier by [36Mis] is likely to be this phase. There is no evidence of eutectic melting of Be-Ta compositions between $Be_{12}Ta$ and Ta below approximately 1700 °C [60Kri].

$Be_{17}Ta_2$ (10.5 at.% Ta): $Be_{17}Nb_2$-type, identified by [59Pai(60Pai)] and [60Zal(61Zal)]. The melting point was reported as 1990 [59Pai], 1980 [60Sto], and 1988 °C [63Get].

Be_3Ta: Be_3Nb-type, identified by [60Zal(61Zal)]. Its melting point is not known.

Be_2Ta: Cu_2Mg-type with a melting point slightly below 1800 °C [59Pai]. This phase was also observed by [60Zal(61Zal)].

Be_2Ta_3: Si_2U_3-type, identified by [60Zal(61Zal)]. The melting point is not known.

$BeTa_2$: Al_2Cu-type, prepared by sintering at 1300 °C [65Gan]. Its melting point was not determined.

(Ta) Terminal Solid Solution. The melting point of Ta is 3020 °C [81BAP]. The initial slope of L/[L+(Ta)] liquidus in Fig. 1 is drawn by assuming no solubility of Be in (Ta) (see "Thermodynamics" section).

Crystal Structures

A summary of crystal structure and lattice parameter data is given in Table 1. Thermal expansions of $Be_{12}Ta$ and $Be_{17}Ta_2$ were measured by [61Boo] (Fig. 2 and Fig. 3) and are given in terms of averaged values by [65Bea] (Table 2).

[80Tan] predicted the existence of a stable or metastable compound, BeTa, having the CsCl-type crystal structure from the study of a series of Be-transition metal systems.

Thermodynamics

Partial Gibbs energies for $Be_{12}Ta$ and $Be_{17}Ta_2$ at 1327 °C were calculated by [73Hul] (also in [73Spe]) from the results of vapor pressure measurements by [64Boo]:

Phase	$\bar{G}_{Be}$, J/mol
$Be_{12}Ta$ (Ta-rich)	13707
$Be_{17}Ta_2$(Be-rich)	13707
$Be_{17}Ta_2$(Ta-rich)	22146

[74Zag] estimated the heat of mixing of the liquid Be-Ta as $-6110\underline{X}(1-\underline{X})$ J/mol using the method developed by [70Kau].

The information above is insufficient for phase diagram calculations.

The initial slope of the L/[L+(Ta)] liquidus has been calculated assuming that (1) the (Ta) phase has no homogeneity range and (2) the lattice stability parameter of solid Ta is $-36570 + 11.105\underline{T}$ J/mol; this was derived from the heat of fusion of Ta given by [83Cha].

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* Indicates key paper.

Table 1 Be-Ta Crystal Structure and Lattice Parameter Data

Phase	Composition, at.% Ta	Pearson symbol	Strukturbericht designation	Space group	Prototype	Lattice parameters, nm a	c	Reference
(βBe)....	0	cI2	A2	Im3m	W	0.25515	...	[82Kin]
(αBe)....	0	hP2	A3	$P6_3/mmc$	Mg	0.22857	0.35839	[81Kin]
$Be_{12}Ta$...	7.7	tI26	$D2_b$	I4/mmm	$Mn_{12}Th$	0.7334	0.4267	[57Bat]
						0.7337	0.4255	[57Gla]
						0.7330	0.4257	[58Che] (a)
$Be_{17}Ta_2$..	10.5	hR19	...	$R\bar{3}m$	$Be_{17}Nb_2$	0.739	1.076	[59Pai]
						0.7388	1.074	[60Zal] (b)
Be_3Ta....	25	hR12	...	$R\bar{3}m$	Be_3Nb	0.453	2.095	[60Zal] (b)
Be_2Ta....	33.3	cF24	C15	Fd3m	Cu_2Mg	0.651	...	[60Zal] (b)
						0.6507	...	[75Stu]
Be_2Ta_3...	60	tP10	$D5_a$	P4/mbm	Si_2U_3	0.650	0.332	[60Zal] (b)
$BeTa_2$....	66.7	tI12	C16	I4/mcm	Al_2Cu	0.6009	0.4902	[65Gan]
						0.6010	0.4890	[72Hav]
(Ta).....	100	cI2	A2	Im3m	W	0.33031	...	[81Kin]

(a) Same group of authors as [57Bat]. (b) Also in [61Zal].

Table 2 Mean Linear Thermal Expansion Coefficients, $\times 10^{-6}$ m/m/°C [65Bea]

Compounds	Temperature range, °C 27 to 316	27 to 982	27 to 1482
$Be_{12}Ta$	10.4	13.7	15.1
$Be_{17}Ta_2$	11.2	14.0	15.7

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Be-Ta Figure Captions

Fig. 1 Be-Ta Assessed Phase Diagram

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Fig. 2 Thermal Expansion of $Be_{12}Ta$ (m/m) [61Boo]
o = Heating, ● = Cooling.

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Fig. 3 Thermal Expansion of $Be_{17}Ta_2$ (m/m) [61Boo]
o = Heating, ● = Cooling.

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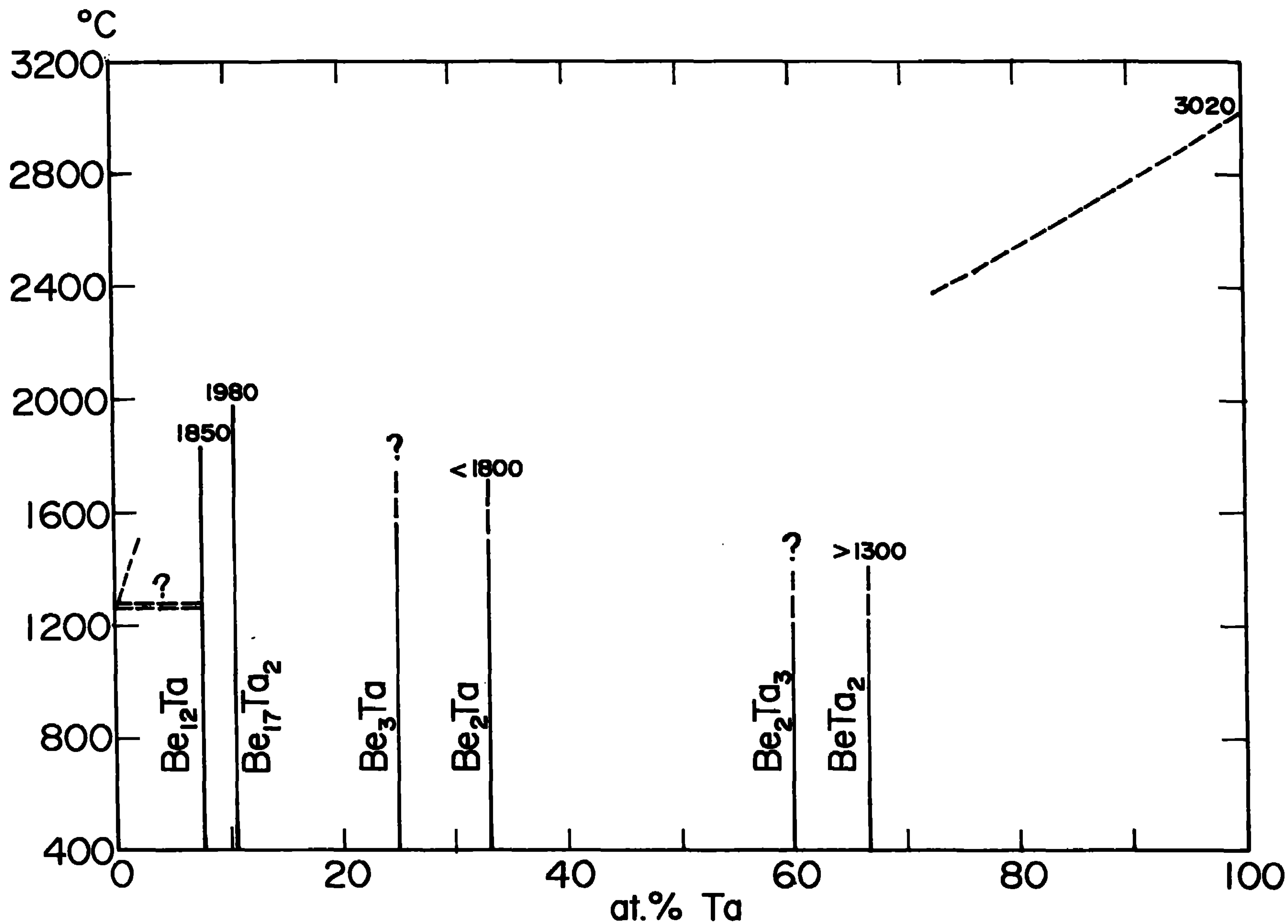
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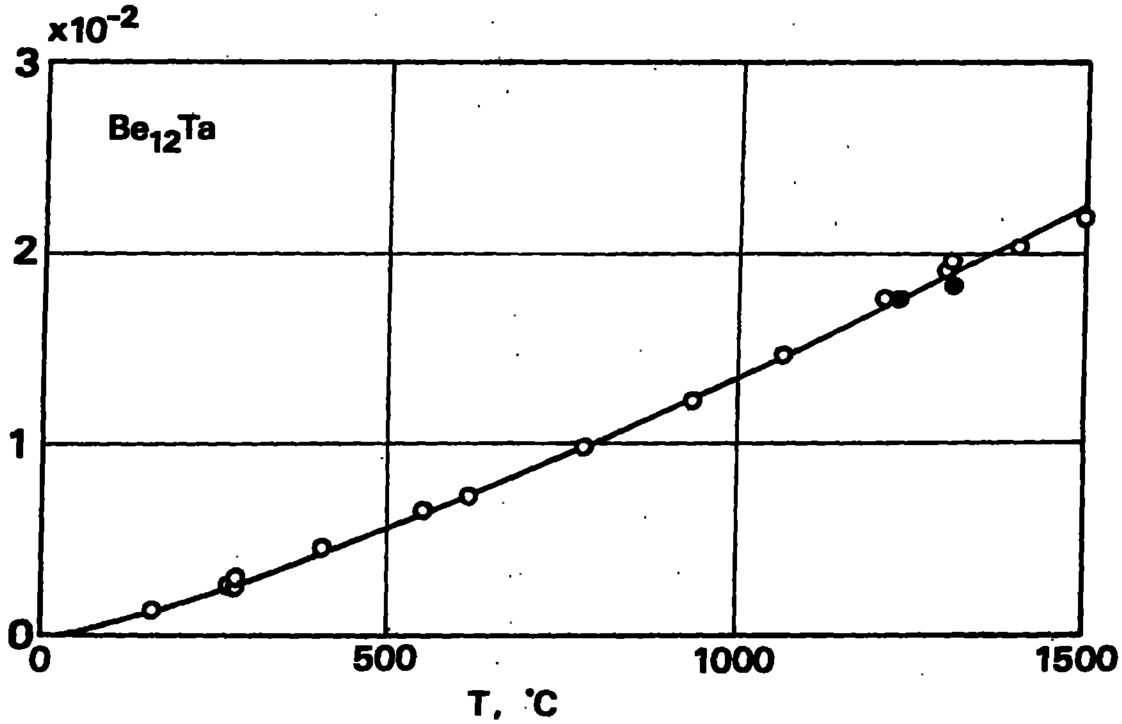
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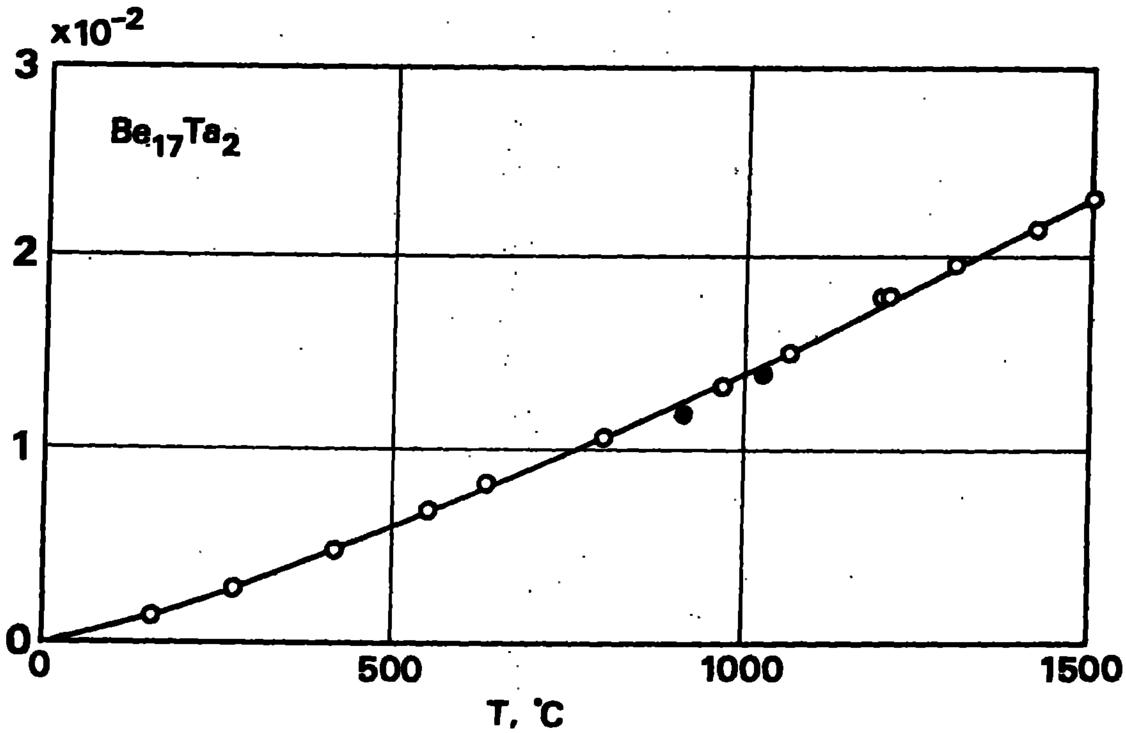
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